THE COMPUTER BULLETIN

VOLUME 1 - NUMBER 4 - DECEMBER 1957/
JANUARY 1958

THE COMPUTER BULLETIN is a publication of

THE BRITISH COMPUTER SOCIETY LIMITED.

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THE COMPUTER BULLETIN is published in alternate months, and is issued free to all members of the Society. Additional copies may be obtained at the published price of each issue from the office of the Society.

The Editors welcome items of interest to members from manufacturers, users and others, and particularly news of forthcoming conferences, courses and lectures.

Editorial and Advertising Offices ---
29 Bury Street, St. James's, London, W.1.

COMPUTERS AND PRESSURE COOKERS

"Don't bring us into disrepute by misusing us." This plea was made on behalf of computers by Professor Hartree at the inaugural meeting of the British Computer Society in London on 21st October.

We are all familiar with the housewife who succeeds in persuading all her friends not to buy a refrigerator, or perhaps a washing machine, or a pressure cooker --- because of a single unfortunate experience. "Don't buy a pressure cooker," she urges, "it will spread rice pudding all over your ceiling." Irrelevant? Perhaps. But something like this could happen to computers. The complexity of computers means that people will tend more than ever to rely on previous experience -- anyone's experience -- in deciding whether to take the plunge.

Those of us who are already faced with all the urgent and difficult problems involved in getting a computer into effective operation may not find it easy to realise that we have a wider obligation than the care of one installation. Yet whether we like it or not, at the present stage of the computer industry the success or failure of a single venture might easily become a signpost to be followed, wisely or unwisely, by flocks of future investigators. Difficult as it may be now to convince a sceptical board of directors of the value of a computer, it would be a hundred times more difficult in the face of a previous notable failure, whatever its cause.

What are the rocks on which a computer venture might founder? Some, such as unreliability of the equipment, are obvious enough. A more hidden danger was dealt with by Professor Hartree: those responsible for the programming must take exceptional care to see that no unforeseen circumstances arise that could invalidate the program. Computer programming is a new kind of discipline appearing foreign to many of us, and yet it is only by complete mastery of this discipline that trouble can be avoided.

(continued on p. 135

MEMBERS' DIARY

JANUARY 1958

7th - London, Northampton College of Advanced Technology, St. John Street, E.C.1., 6.15 p.m. -- D.W.Davies: The Logical Design of the ACE at the National Physical Laboratory.

13th - Glasgow, Royal College of Science and Technology (Room 406, Montrose Extension), 7 p.m. -- L.Griffiths (Rolls-Royce Ltd.): Experiences of Using a Digital Computer in Industry.

14th - Manchester, College of Science and Technology (Room G.41.X), 7.30 p.m. -- Dr. S.Gill (Ferranti Ltd.): Parallel Programming.

15th - Leeds, Art Gallery, 6.30 p.m. -- (INAUGURAL MEETING) D.W.Hooper: The Profession of Computing - General Practitioners and Specialists.

20th - London, Caxton Hall (York Hall), Westminster, S.W.1., 6.15 p.m. -- Dr. N.Levin (Rank Precision Industries Ltd.): The Physical Properties of Xerography.

23rd - Newcastle, Stephenson Buildings, 7 p.m. -- (INAUGURAL MEETING) D.W.Hooper: Programs and Programmes.

FEBRUARY 1958

4th - London, Northampton College (as above), 2.30 p.m. -- Dr. K.D.Tocher: The Computer in Operational Research and Cybernetics.

10th - Glasgow (as above) -- Meeting of Members to discuss the formation of Study Groups.

17th - London, Caxton Hall (as above) -- Professor A.C.Aitken (Edinburgh University): Mental Arithmetic, an historical review with demonstrations.

24th - Glasgow (as above) -- Dr. S. Gill (Ferranti Ltd.): Parallel Programming.

25th - Manchester (as above) -- A.J.Barnard (City Treasurer, Norwich): Application of a Computer to the Work of Norwich Corporation.

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continued fron p. 133)

It is one of the tasks of the British Computer Society, by bringing together designer and user, expert and novice, to minimise the risk of future projects going astray. In the past computers have already suffered one setback through the failure of men to appreciate their special problems. If Charles Babbage had been able to plan his work more surely, or if the Government of his day had been able to appreciate its potentialities as well as its difficulties, it is likely that large automatic computers (though not electronic ones) would have been working for many decades past. This in turn would have meant that many of our existing industries would have grown up in a world in which automatic computing was commonplace. Who can say what difference this would have made to our ideas of management?

Computer designers have a saying reserved for times of stress: "The trouble with computers is people." Let us resolve to see that this remark is never justified.

MARCH 1958

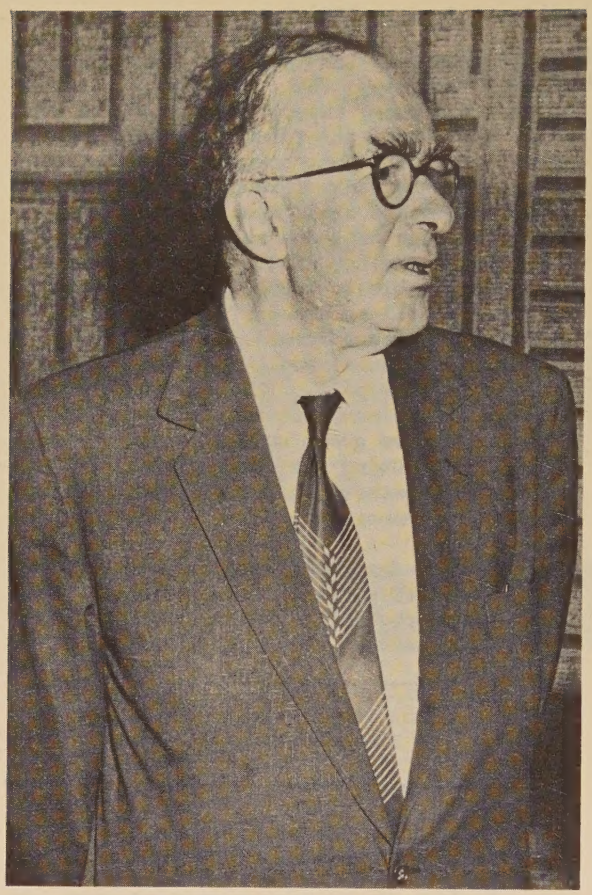
5th - London, Northampton College (as above), 2.30 p.m. -- C.Strachey.

11th - Manchester (as above) -- D.W.Hooper: Integrated Electronic Data Processing.

17th - London, Caxton Hall (as above) -- D.S. Greensmith and G.Thompson (Boots Pure Drug Co. Ltd.): A Case Study in Electronic Data Processing.

17th - Glasgow (as above) -- P.V.Ellis (Powers Samas Ltd.)

/Hon. Secretaries of Groups and Branches are requested to advise the Editors as far in advance as possible of all meetings and other activities for inclusion in this column/



THE MACHINE'S-EYE VIEW

D.R. HARTREE F.R.S.

An Address to
THE BRITISH COMPUTER SOCIETY LIMITED
at their
INAUGURAL MEETING
on the 21st of October 1957
at the Senate House, University of London

Douglas R. Hartree, F.R.S., has been Plummer Professor of Mathematical Physics in the University of Cambridge since 1946. Many years spent in hand computations, arising in atomic physics and in other scientific and technical contexts, enabled him quickly to appreciate the importance of automatic computers.

He was mainly responsible for the introduction of the mechanical differential analyser to this country some 25 years ago, and at Cambridge he has taken an active interest in the EDSAC since its conception. He served for a number of years on the Executive Committee of the National Physical Laboratory, and is a member of the D.S.I.R. Advisory Committee on High Speed Calculating Machines.

The name of this Society, the British Computer Society, might be read as meaning a Society for British Computers, and I almost wondered if I would see a Deuce, an Edsac, or a Pegasus at this meeting. But none of the machines themselves are present, and in their absence I am taking it on myself to speak for them.

Perhaps I can do this the better through having had a fairly long and wide practical experience of numerical work, starting in earnest with ballistic calculations in 1915. This work involved the development of numerical methods for various calculations, as well as extensive use of them.

It impressed on me the power and scope of numerical methods in application to problems for which no formal solution can be found, and even, sometimes, to problems which have complete formal solutions. It also impressed on me the importance of adequate current checking in large-scale numerical work.

Since then I have worked on applications of numerical methods in various problems of pure and applied science in contexts as diverse as atomic structure, fluid dynamics,

radio propagation, magnetron theory, non-linear oscillations, internal ballistics of rockets, and the dynamics of the turning of tracked vehicles.

I once estimated that the total amount of time I have spent in numerical work in these and other contexts is of the order of 10 000 hours. and perhaps I might add as a point of interest, only a very small proportion of that time, perhaps two percent, has been concerned with matrix calxulations; I am quite aware that some people do have large amounts of matrix calculations to do, but in over 40 years experience of numerical work, very little work of this kind has come my way.

I have digressed somewhat from my title, to satisfy you, I hope, that I have enough first-hand experience of numerical work to make me qualified to speak on behalf of the computers. Further, I had the good fortune to be one of the early users of the Eniac, the first electronic digital computer, developed by Eckert and Mauchly at the Moore School of Electrical Engineering of the University of Pennsylvania; indeed I think I was the first non-American to use this machine.

In the course of this work on the Eniac I had an experience to which I shall refer later, from which I drew a moral which I expressed as follows:---(*1)

"In programming a problem for the machine, it is necessary to take a "machine's-eye view" of the operating instructions, that is, to look at them from the point of view of the machine which can only follow them literally without introducing anything not expressed explicitly by them, and to try to foresee all the unexpected things that might occur in the course of the calculation, and to provide the machine with the appropriate operating instructions in each case. And this is not so east as it sounds: it is quite difficult to put oneself in the position of doing without any of the hints which intelligence and experience would suggest to a human computer in such situations."

I want to take this as my text, and particularly to make two points. First that in a hand computation an intelligent and experienced operator will often exercise that intelligence, and intuition, based on experience, about the sort of way in which the calculations are likely to go, and do this almost automatically and unconsciously; whereas the machine is an approximation to an unintelligent and inexperienced computer, and has not got this background of knowledge and experience unless it is explicitly built into the program.

Secondly, on behalf of the machines I want to emphasise that machine errors are not the only sources of wrong results. Such results may also occur through the machine being supplied with the wrong data, through program errors, or through use of a program which carries out, however correctly, a process which is unsuitable for obtaining the results required.

As a first illustration, I shall consider a homely example, though rather an unrealistic one because a realistic one would require a good deal of explanation, and this would take more time than I want to spare at this stage. Suppose one is using a computer for a pay-roll calculation, and by a mistake of programming the order which should result in income tax being deducted becomes an add order instead of a subtract order.

The machine doesn't know that Her Majesty's Commissioners of Inland Revenue don't work that way (unless one has included this in the program); from the machine's-eye point of view it has done what it has been asked to do. Of course the programmer could include a test that the order which should dedudt the income tax really is a subtract order, but if one went so far towards taking the machine's-eye view to recognise that such a test might be advisable, one would be likely to take such care with the programming that such a test would not be necessary.

The situation is not likely to arise, however, in the crude form of an add order taking the place of a subtract order in the program as drafted; and anyway this would be shown up in the simplest test. What might happen, and would be much more insidious if it did happen, is something like this. The payroll program has been drawn up and used for two years; the man who drew it up has left and so has his successor, and no one is left who knows precisely how the program works; it has been working satisfactorily and no one has had occasion to look into it. But it happens (and this is where I am being unrealistic in detail, though not, I think, in principle) that when the number of individuals on the payroll gets above 2 000, say, then in some other part of the program, which is intended to deal, perhaps, with sick-leave allowances, an overflow results in the order

for the deduction of income tax being changed from a subtract order into an add order. This has not been spotted by the original programmer, and was not shown up in tests because the number on the payroll was then only 800, so the program was never tested for larger numbers.

Again from the machine's-eye point of view there is nothing wrong with the results; unless some test or check has been included in the program, it has no basis for recognising that they are faulty.

This illustrates two things, first the need for adequate checking, and secondly the danger of the argument that because a program has been tested and has worked correctly in the past, it can be relied on to work in the future in the absence of machine error. It isn't necessarily so. As in the example I've just considered, a program may be quite correct for the context for which it was originally drafted, but unsuitable, in a way which neither the original planner nor the current user amy appreciate, in a context only slightly different.

The example I have just considered is admittedly somewhat unrealistic. The others I shall consider, however, are all drawn from real life.

The first example is one of the machine producing the wrong answers simply because it has been supplied with the wrong data --- and I must emphasise that this really happened (I know it did because I was the victim). I happened recently to be working where there was a machine and a program for evaluating

$$\int_0^x s^k f(s)g(s)ds$$ as a function of x,

given the functions $f(x)$ and $g(x)$, and the value of k. I wanted some results of just this kind, so handed over tables of my input functions $f(x)$ and $g(x)$ for the calculations to be carried out. As it happened, the available program required the input functions to be at a standard set of values of x, and, over part of the range only, my values of the input functions were not at the standard values of x, so that some interpolation was required. This interpolation was entrusted to a human computer who was, I think, inexperienced and was certainly woefully deficient in a sense of the need for adequate checking. The interpolated values were input to the machine without any checking, and some of them were just plain wrong. I had assumed that elementary precautions such as checking the interpolations would have been carried out as a matter of course, and would have accepted the results except for one indication that some of them were faulty; some of the integrals should have tended to 1 exactly as $x \to \infty$, and the machine values did not. But this check had not been embodied in the program and so was outside the range of the machine's-eye view.

As an example of faulty results arising from use of an unsuitable process, I shall consider one method for the numerical integration of a first-order differential equation $dy/dx = f(x,y)$. This method** is shown diagrammatically in Figure 1.

Let $x_{j-2}, x_{j-1}, x_j, x_{j+1}$ ..... be values of x at equal intervals δx, and suppose the integration has reached x_j. A first approximation to y_{j+1} is found by the formula

$$y_{j+1} = y_{j-3} + 4(\delta x)\left[y'_{j-1} + \frac{2}{3}\delta y'_{j-1}\right],$$

which is a modified form of Simpson's rule, for integrating over a range $4\delta x$ using differences at interval δx. This formula involves only quantities known at this stage of the integration. This approximate value of y_{j+1} is then substituted into the differential equation to give a value of y'_{j+1} and hence of $\delta^2 y'_j$, and an improved value of y_{j+1} obtained by use of Simpson's rule in the usual form

$$y_{j+1} = y_{j-1} + 2(\delta x)\left[y'_j + \frac{1}{6}\delta^2 y'_j\right].$$

This method looks very attractive for a digital computer, and is recommended in Milne's book without qualification.

However, it can be shown(*2) that for the equation

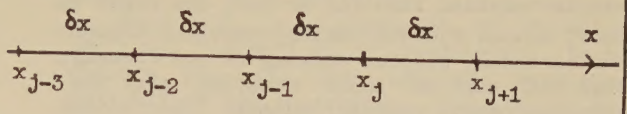
$$dy/dx = -ky + g(x) \qquad (1)$$

the effect of an error (rounding error, truncation error or mistake) builds up like $(-1)^{x/\delta x} e^{kx/3}$; and I think it probable that

** It is called 'Method VII' in W.E.Milne's book on "The Numerical Integration of Differential Equations"(John Wiley, New York, 1953)

FIGURE 1

$$\frac{dy}{dx} = (x,y)$$

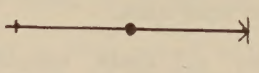


"Predictor":

$$y_{j+1} = y_{j-3} + 4(\delta x)\left[y'_{j-1} + \tfrac{2}{3}\delta^2 y'_{j-1}\right]$$

"Corrector":

$$y_{j+1} = y_{j-1} + 2(\delta x)\left[y'_{j} + \tfrac{1}{6}\delta^2 y'_{j}\right]$$



for the equation

$$dy/dx = -f(x)y + g(x) \qquad (2)$$

with $f(x) > 0$, the effect of an error builds up like

$$(-1)^{x/\delta x}\exp\left[\tfrac{1}{3}\int f(x)dx\right]$$

approximately.

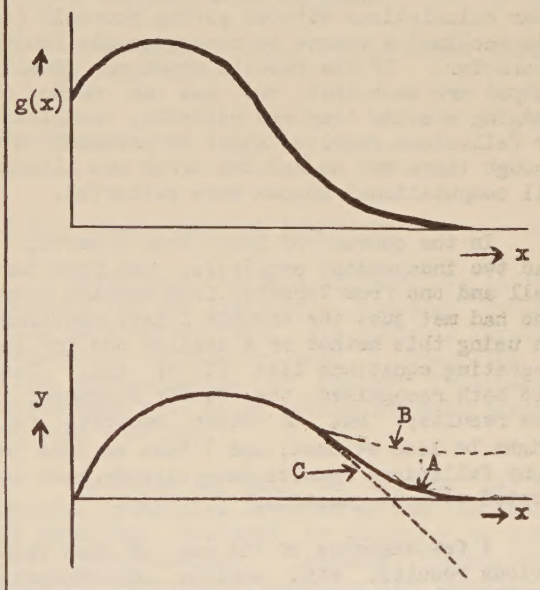
This error in the solution does not increase with drastic rapidity, and it may be tolerable if the range of kx, or of $\int f(x)dx$, is, say, 1 or 2, or even 10 ($e^{10/3}$ is about 28), but not if this range is 100 or more ($e^{100/3}$ is about 10^{14}, so that over such a range the effect of rounding errors would probably swamp the real solution completely). The program might be tested by carrying out an integration through one or two intervals, or even ten, covering a range perhaps $\frac{1}{2}$ to 1 in kx, and this fault would never show up. Indeed it is not a fault in the program, but in the process programmed.

This error in the solution is oscillatory, and would become evident if the value of y for each interval of the integration were output by the machine. But it might be that, to keep down truncation errors, an integration interval had been used smaller than the interval at which results are wanted, so that results are only output at every two intervals, or perhaps every four or eight. Then, if $g(x) \to 0$ for large x so that the correct solution behaves like curve A on Figure 2, the machine output would only give points on a curve like B, or on one like C.

FIGURE 2

$$\frac{dy}{dx} = -ky + g(x)$$

$$y = 0 \quad \text{at} \quad x = 0$$



One possible reaction is "Both the machine and the program have been tested and are all right; so the results must be right, though they look a bit odd" (and I have heard similar comments, in other contexts, about some equally impossible results). Of this I would only say "Don't you believe it". For a simple equation like (1) or (2), one ought to know, almost without taking conscious thought and certainly without working it out formally, that with such an input function g(x) the solution cannot possibly behave like either of the curves B or C. The reaction should be just "These results are wrong; period". And if this would not be your reaction, you should not consider yourself fit to be left alone with a computer --- at least to do calculations of this kind.

However, all these considerations are outside the range of the machine's-eye view (unless some test of the behaviour of the solution for large x has been included in the program). From that point of view there is nothing faulty about the results; the machine has done what it has been asked to do, and if it should not have been asked to do this, how can it know?

If the solution y were output, you could supplement the machine's-eye view with your own knowledge and experience. The real danger lies in using the faulty solution in further calculations without giving yourself (or the machine) a chance to recognise its faulty character. If the results which are finally output are such that one has no means of judging whether they are reliable, completely fallacious results might be produced although there was no machine error and although all computational checks were satisfied.

In the course of less than a month, I had two independent enquiries, one from Harwell and one from Toronto, from machine users who had met just the trouble I have mentioned in using this method or a similar one for integrating equations like (1) or (2). They had both recognised the faulty character of the results; but in other contexts this might be less evident, and I have no idea how many fallacious results have already been accepted without question.

A few examples of the use of such fallacious results, with serious consequences, might well result in the machines falling into disrepute, although the fault is not one of the machine at all, but of the user. And with the increasing use of the machines, it is becoming increasingly likely that they will sometimes be used by people without adequate experience, and perhaps without adequate sense of the need for checking (as in the case of using the wrong data which I have already mentioned) or an adequate sense of responsibility; and I think there is a real danger of the machines falling into disrepute in this way. I started by saying I was going to speak for the machines, and one message I think they might ask me to bring to you is: "Don't bring us into disrepute by misusing us".

I want now to refer to another example in which failure to take the machine's-eye view led to erroneous results --- which fortunately were detected, though again by consideration outside the range of the machine's-eye view.

In the work I did on the Eniac, I happened to want the machine to evaluate $(1 + z)^{-1/9}$, where z was a number evaluated by the machine and which should lie between 0 and 1. Being then young and innocent, I planned to evaluate $(1 + z)^{-1/9}$ by an iterative process, using a table for the range $z = 0$ to 1 at intervals 0.01 to give the first approximation; two iterations would then give the accuracy that I required. However, the values of z themselves were evaluated by a process of successive approximation, and I had overlooked that in this process negative values might occur, although in the final solution z would always lie between 0 and 1. Now -0.013 (for example) was represented in the machine as $\bar{1}.987$ ($\bar{1}$ standing for a sign digit), and, as originally programmed, the machine took the first two digits to the right of the decimal point as the value of the argument for which to take an entry from the table, so that if z took the value -0.013, the machine would take the value of $(1 + z)^{-1/9}$ for $z = 0.98$ as the first approximation for the iterative process for $(1 + z)^{-1/9}$, and then two iterations were by no means adequate to give the accuracy required.

In this case, again, on the machine's-eye view there was no fault; the machine had done precisely what it had been asked to do, and it had no means of knowing that I had not foreseen that z might become negative, or that if this did happen, it ought to do something different from what I had explicitly asked it to do.

This does not mean that the machine could not have been programmed to deal correctly with the situation; when I recognised what was happening, only a small modification to the program was necessary in order that negative values of z should be handled correctly. The point is that without the appropriate instructions, the machine could not deal with the situation by itself; indeed it had no way of recognising that there was a situation to be dealt with at all. Also the situation is not one which would arise in a hand calculation, since then the occurrence of negative values of z would make no difference to the method of finding $(1 + z)^{-1/9}$. Probably the fact that it would not occur in a hand calculation was one reason why I overlooked the possibility that it might occur in a machine claculation; I had not sufficiently acquired the machine's-eye view. It was from this experience that I drew the moral I quoted earlier.

Another danger is a program which works except for particular numbers or combinations of numbers in it, these not being recognised by the programmer, so that they are unlikely to be used in any test. For a real example of this, I refer you to a note(*3) entitled "The Adventures of a Blunder", concerning an obscure fault in a subroutine for the Edsac for calculating square roots of numbers expressed in floating decimal form. The point of this lies in the details, and I will refer you to the original note for these.

I hope I have said enough to make you realise that machine errors are not the only source of faulty results, even when using tested programs believed to be correct. Some such results are consequences, not of program errors, but of choosing the wrong process to program in order to get the result required. To avoid this, some knowledge of numerical analysis, as well as of programming, is required; you must have adequate knowledge, not only of how to program, but also of what to program. The machine, however, has no such knowledge, and cannot recognise a numerical process as being unsuitable for the calculation you want to make; it may verify that it has done correctly the arithmetic that you have asked it to do, but how can it recognise that you ought not to have asked it to do it? And on this note I will end with a final message from the machines: "Please remember how much we don't know".

References:

*1 D.R.Hartree - Calculating Instruments and Machines (Univ. of Illinois Press, 1949; Camb. Univ. Press 1950)

*2 D.R.Hartree - Proceedings of a Convention on Digital Computer Techniques, April 1956 (Proc. Inst. Elect. Eng. 103, Part b, Supplement No. 1, p.149)

*3 R.A.Brooker, S.Gill, & D.J.Wheeler (MTAC, 6, 112, 1952)

NEW COLLOQUIA AT IMPERIAL COLLEGE

Imperial College has announced a new series of colloquia on Numerical Analysis and Machine Computation. The meetings will be held monthly, on Wednesdays at 3 p.m., in the City and Guilds College, Exhibition Road, S.W.7. They will be open to all interested.

The first three will be:

January 22nd: Prof. G. G. Bickley - "Some Matrix Solutions of Partial Difference Equations".

February 19th: Dr. E. T. Eady - "Complex Eigenvalues of an Elliptic Boundary-Value Problem in Fluid Mechanics".

March 19th: Prof. G. A. Barnard - "The Coding Theorem, and So-Called 'Self-Correcting' Codes".

N.P.L. PLANS COMPUTER SYMPOSIUM

While many overseas visitors are in this country for the Electronic Computer Exhibition in November 1958, the National Physical Laboratory intends to hold a Symposium on "The Mechanisation of Thought Processes". Attendance will be by invitation only, limited to less than 200.

The first day will be devoted to the general principles involved in the imitation of thinking, followed by sessions on automatic programming, language translation, pattern recognition, learning and information retrieval. The final day will be concerned with applications in clerical mechanisation and biology.

INAUGURAL MEETING OF THE SOCIETY

A large gathering of Members, many from long distances, assembled in the William Beveridge Hall of the Senate House, London University on the evening of the 21st October for the Society's Inaugural Meeting.

The President (Dr. M. V. Wilkes - shown above) was in the Chair, and introduced the guest speaker, Professor D.R.Hartree, whose address on "The Machine's-Eye View" is reproduced elsewhere in this issue.

Earlier there was an informal gathering of Members and guests for refreshments in the adjoining Macmillan Hall. Those present included many well known figures in the computing field; a number of candid camera shota taken during this social conversazione are shown on the opposite page.

Mr. E.N.Mutch Mr. R.G.Dowse
Mrs. Gearing Mr. H.W.G.Gearing Mr. R.E.Stevens Miss J.Auld
(Personal Assistant)
Mr. A.Geary Mrs. Bray
Mrs. Hough Miss D.J.Aldis
(Assistant Secretary)
Mr. E.C.Clear Hill
Mr. J.P.Hough Mr. A.J.Bray
(Honorary Treasurer) Mr. E.E.Boyles Mr. W.E.Reed
(Secretary)
Mrs. Hooper
Mrs. Wilkes
Dr. M.V.Wilkes Mr. D.W.Hooper
(President) (Chairman of Council)

THE CHAIRMAN'S LUNCHEON

On the day of the Inaugural Meeting, the Chairman of Council, Mr. D.W.Hooper, and Mrs. Hooper entertained the President and Mrs. Wilkes, and Members of Council and their ladies, to a luncheon at the Rubens Hotel.

A number of the guests are shown in the composite photograph above.

In a short informal welcome to the President, the Chairman expressed the pleasure of Council at Dr. Wilkes' acceptance of the office. He was also able to announce that registration of The British Computer Society Limited, as a company limited by guarantee, was now complete, and he displayed the certificate of incorporation.

REGIONAL BRANCH FORMATION

INAUGURAL MEETING IN MANCHESTER

The inaugural meeting of a Branch of the Society was held in Manchester on Monday 14th October 1957, at the Manchester College of Science and Technology. Dr. B.V.Bowden, Principal of the College, was in the Chair.

Following Dr. Dowden's address, summarised overleaf, Mr. A.J.Bray, a member of Council, spoke on the Society's formation and its aims.

Thanking the organising committee for its work in the Manchester district, and for giving him, on behalf of Council, an opportunity of telling those present something of the objects of the Society, Mr. Bray said that on that day (14th October) the Society's application to the Registrar of Companies for incorporation under the Companies Act 1948 had been approved, for a company limited by guarantee. Reminding Members that permission to include in the name of a company the words 'the' and 'British' was seldom given, he felt they would be interested to know that most of the preparatory work prior to the application being lodged with the Board of Trade was carried out by Members of Council themselves.

"In drawing up our Articles of Association, we were very conscious of the wide interest, in all parts of the United Kingdom and overseas, in furthering the development of the computer art; Council is empowered, therefore, under the Articles to approve of the establishment, in any part of the United Kingdom or British Commonwealth, or elsewhere, of specialist or regional groups and branches of the Society. It is our hope that, as branches form in different parts of the country, so they will be combined together to form, with Council's approval, Regional Groups; as each of such Regional Groups is formed, it will have the right to nominate one Member of Council."

After describing briefly the Society's organisation, and arrangements for meetings and publications, Mr. Bray continued "As many of you who are here this evening will already know, the Society through its representatives took an active part in the setting up of the British Conference on Automation and Computation, and is a member of Group B, concerned with the development and application of computers, automatic controls and programming techniques.

"In describing to you the activities which have been arranged for holding lecture meetings, study groups and colloquia, I have been referring to arrangements made for the London area and, as branches of the Society form, the arrangements they choose to make for holding their own meetings will be at the sole discretion of each branch committee.

"I should like to emphasise that, though we shall be only too willing to assist Branch Committees to obtain the services of lecturers and to set up a study group organisation, if they so wish, it is the policy of Council that each Branch shall develop along lines of its own choosing within the framework of the Society's general policy."

Dealing with the various classes of membership and the financial position of the Society. the speaker stressed that the Society "is financially independent of all other bodies and relies entirely for its existence on the subscriptions which it receives from the Members. Council considers that it is of the utmost importance that this principle of financial independence is carefully followed and safeguarded if the Society is to continue to serve the best interests of its Members."

(continued overleaf

THE ROLE OF COMPUTERS IN GREAT BRITAIN

DR. B. V. BOWDEN AT MANCHESTER MEETING

"The computer business is growing as fast, if not faster, than any other industry in the world. We have a wonderful chance to establish ourselves as leaders in the field; the chance will not be ours for long. Let us hope we can seize it while it is here."

These words formed the climax of the address which Dr. B. V. Bowden, Principal of the Manchester College of Science and Technology, gave at the inaugural meeting of a Branch in Manchester of the British Computer Society on October 14th.

He began by drawing attention to the changes which had occurred in the industry in the four years since he had left it. At that time there were only half a dozen electronic computers in England, but their achievements were recognised as a major advance on earlier types of equipment. We looked forward with confidence to the development and application of computers, but no one foresaw the almost explosive speed with which these developments would take place.

In the last four years the speed of calculation has improved by as large a factor as that by which the first electronic computers bettered the desk machines of 1952. Machines now being designed may well achieve an increase in speed over the present machines as great as any advance made in the past. It is important to realise that an increased speed may make possible and profitable certain operations which would otherwise never be done at all. For example, the Meteorological Office espects soon to be able to predict our weather before it happens, by solving the equations which describe the behaviour of the Earth's atmosphere; in this case speed is vital.

It was unfortunately true four years ago that the Americans were devoting far more effort and resources to computing machines than we were in this country. This year they sold about $350m. worth of computers and forecast that they would sell about $1 000m. worth in 1960 and $2 000m. worth in 1965.

Large though the American computer industry has become, it cannot even supply its home market, and we have in this country an extraordinary opportunity to establish our own products. However, the funds which are now at the disposal of British firms are far too small. It is very much to be hoped that the necessary capital will be found so that we shall be able to develop this enormously important new industry.

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The meeting then unanimously resolved that, subject to the approval of Council, a Manchester Branch of The British Computer Society Limited should be formed. Dr. B.V.Bowden, M.A., Ph.D., M.I.E.E., Principal of The Manchester College of Science and Technology, was elected Chairman of the following committee to serve for the period to the 30th April, 1958, the end of the Society's year; Messrs. W. Appleyard, A.C.Baker, H.Cotton, Drs. R.L. Grimsdale, C.B.Hazelgrove, Messrs. R.Kerr, A.J.Platt, G.D.Royle, R.Scruton, J.W.Wright and W.Wright. Honorary Secretary is MR. H.G.A. CORDWENT, to whom al enquiries should be addressed, at the College of Science and Technology, Industrial Administration Department, Sackville Street, Manchester 1.

BIRMINGHAM'S FIRST MEETING

Some of the many Members and others who attended the Inaugural Meeting of the Birmingham Branch. On left is Dr. D.A.Bell, of Birmingham University; centre is Dr. A.D.Booth, of Birkbeck College, and a Member of Council, who gave the opening address.

Birmingham Branch held its inaugural meeting on Friday, 1st November 1957, at the University, with Dr. D. A. Bell in the Chair.

An address was given by Dr. A.D.Booth, Director of Birkbeck College Computation Laboratory, and a Member of the Society's Council, on "Computers and Modern Society" (to be reproduced in a future issue of THE COMPUTER BULLETIN.

Mr. A.J.Bray, a member of Council, then spoke on behalf of Council, as at other inaugural meetings of Branches, on the aims and objects of the Society. After reminding those present that the Society was now a limited company, and dealing with the formation of specialist and regional branches and groups, Mr. Bray referred to the development of the organisation of the Society: "to carry on the day-to-day affairs we had first to establish an organisation which was extremely flexible and the staff of which were personally interested in furthering our objects. This was accomplished by developing and expanding the office procedures and organisation already set

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up by the London Computer Group; I should like to pay tribute here this evening to the very great deal of hard work carried out by the Secretary, Mr. W. Reed, since his appointment by the Society on the 1st September, and by the two fulltime members of our permanent staff who joined us in the early part of this year."

After outlining the Society's programme of lectures, study groups and colloquia, he went on to say something of the publications; "the first three issues of THE COMPUTER BULLETIN, published by the Society, have now been issued to all Members, and this publication will continue to be issued, free, to Members, six times each year. The third issue contains the published reports of the London Computer Group's study groups for 1956/57 on subjects in the business field and will, I feel sure, be of considerable practical use to all those interested in this aspect. All new Members on joining, up to 30th April 1956, will receive all back issues of THE COMPUTER BULLETIN so that they can obtain the full value of the experience which has already been gathered."

Mr. Bray also dealt with the Society's plans for publishing a quarterly Journal, and other advantages of membership. Finally, he described briefly the financial arrangements proposed for Branches, stating that it was the Society's intention that "Branch finances will be based on a per capita allocation according to the number of members taking part in respective branch activities; when the programme for the formation of branches of the Society is nearing completion, detailed arrangements will be worked out with representatives of the Branch Committees. Until such time as this has been done, the Society reimburses each Branch as it forms for the expenditure incurred, up to agreed amounts."

Dr. Bell then explained briefly the proposed arrangements for a Branch in Birmingham, underlining the personal aspect of membership. The meeting then resolved that a Birmingham Branch should be formed, subject to Council's approval, and elected the following Committee under the Chairmanship of Dr. Bell: Messrs. S.J.Careless, H.G.Carpenter, J.C.Cluley, C.H. Gerrard, A.Griffiths, E.W.Hiscox, R.R.Kiteley, Dr. Mullineux, Messrs. W.E.Robertson and A.W. Swann, with Mr. B. W. Sutherland as Honorary Treasurer; MR. E. C. LAVALETTE is Honorary Secretary, at 10 Cottage Lane, Marlbrook, Bromsgrove.

CO-ORDINATING COMPUTER DEVELOPMENTS

Manufacturers of computing equipment have begun to work towards the standardising of components and auxiliary equipment for computers, through the Radio Communication and Electronic Engineering Association.

The Association has set up a Data Processing Section under the chairmanship of Mr. C. Metcalfe of E.M.I. Electronics Ltd. Four technical working parties are dealing with various classes of product.

COST ACCOUNTANTS' RESIDENTIAL COURSES

The Institute of Cost and Works Accountants believe that the majority of large businesses will have electronic data processing within 10 years, and that many others will be using service bureaux.

They have therefore arranged a series of 5-day residential courses in automatic data processing for the early part of 1958.

The courses cover what a computer is and what it can do, a survey of installation and administrative problems, and a practical example of a wages installation.

The papers will be circulated in advance and those attending will be expected to have some basic theoretical knowledge of computers; a recommended reading list has been compiled.

BRITISH COUNCIL RUNS COMPUTER COURSE

People from Australia, Austria, Belgium, France, Norway, Poland, and Yugoslavia attended a two-week course on digital computers organised by the British Council during October 28 - November 9.

Leader of the course was Dr. A. D. Booth (who is a member of the Council of the British Computer Society). The visitors heard a number of lectures by British experts and saw University computing Laboratories and manufacturing concerns.

GLASGOW BRANCH FORMS

ADDRESS BY DR. D. C. GILLES

A full programme was provided by the organisers of the Glasgow Branch of the Society for their inaugural meeting on the 11th November, with Dr. D. C. Gilles, B.Sc., Ph.D., Director of the Computing Laboratory, Glasgow University, in the Chair.

Mr. T.B.Simpson, C.A., introduced a film to the audience as a "Communications Primer"; this was an American film privately made in 1954: it describes the science and philosophy of communications and, among other matters, channels of communication in an EDP system.

In his address, Dr. Gilles then welcomed the formation of a Branch of the Society in Glasgow as a happy augury "for the cooperation between the University and local industry, which has been so beneficial to both in other fields, and which, I trust, will prove to be so in this field.

"It has always been so striking to me that in these electronic digital computers, we see, practically for the first time in the field of calculation, something developed within the precincts of Universities being applied to business and industrial use. Up to now, we of the scientific world have usually gone to the manufacturers to see what they could offer in the form of calculating equipment, be it desk machines of the conventional hand or electric kind, accounting machines -- especially the National which was discovered for scientific use in the 1930's -- and punched card equipment. This I have no doubt has been good for both of us.

"To energetic salesmen it has often meant the introduction of a world of figures which they but dimly realised, and to scientists -- to me at least -- it has meant that some of the activities that go on upstairs in the Finance Department or behind the counter in my bank are not so obscure after all. True, we found the manufacturers of the equipment increasingly alive to the needs of scientists, but there bread and butter job, their daily task, was to sell such machines in their hundreds to the office whilst they were sold in ones and twos to scientists.

"Any developments they made were designed primarily for office use, and not for ours, but frequently we found an application for it. To take a trivial example, the introduction in the National Class 31 Accounting Machine of a lock such that the machine would stop if an overdraft or debit balance occurred was immediately realised to be valuable in table-making applications of the machine, as it made the operation of subtabulation practically automatic.

"However, the development of automatic digital computers seems to be in the opposite direction. Proposed first by Babbage over 100 years ago, the ideas lay dormant and forgotten, until 1937, when Professor Aiken of Harvard University conceived that IBM equipment could be used to make an automatic machine.

"The stimulus had come from the Universities, and in the next few years much development was done there. It was later, when their potentialities were realised, that applications to the business world were conceived, and even now much more use is made of these machines scientifically. They are a vital tool for his use, be it inside the University or elsewhere.

"At this point I should like to say a few words about the University Computing Laboratory, because I believe that it is here that it will play its part. Established by the joint financial contribution of local industry and the University, it is principally a computing laboratory, that is, our primary interests are in the use of digital computers and not their construction and development. We exist to make the computer available to

all who may wish to use it, within the University and outside, and, as I see it, there are several ways in which we shall fulfil this aim.

"Firstly, we shall have to provide information about the use of digital computers, with special reference to the machine we shall be having at Glasgow. Such courses should, I feel, be of two kinds, a general course aimed at providing information on digital computers in general run under the aegis of the Extra-mural Department, and a programming course designed for those who will actually be using our machine. We are aiming to hold one or two of these latter programming courses next year, before the machine is working.

"Secondly, of course, we shall provide courses on numerical methods. these we hope to direct to both specialists and beginners in the subject, and will be aimed at scientific uses of the machine.

"Finally, we exist to provide a service, of a kind, for local industry. Despite the development in computers, they are still a rarity in this country --- something under 50 all told, at the present time --- and their potentiality has not been fully developed by industry.

"The machine we are getting will be available --- at an appropriate cost, of course --- to any who wish to use time on it. Such people will be expected to program their problems themselves and to actually operate the machine, although naturally we will give such advice and guidance that may be necessary.

"There will be quite an appreciable amount of time available in this way -- to be economic, a machine should be used as much as possible throughout the 20 odd available hours in the day -- routine maintenance always takes 2 - 3 hours. Needless to say, I should welcome enquiries from those who feel they would be interested in using the machine.

"Most of this activity, of course, is directed principally to those whose interests are scientific rather than commercial. Our courses on programming will be designed to this end with the one exception of the general course.

"The machine, too, will be more suitable for scientific use --- a large amount of calculation compared with the data to be input and output --- rather than commercial applications in which the reverse is generally the case. But, I feel very much, that there are large fields in which we are all interested, the basic bricks so to speak are used by all of us.

"Although our output problems are not so vital as those of the business world, we too have problems where a vastly increased speed of output would be of value."

Turning to the role of the Society, Dr. Gilles continued: "It seems to me that one of the great advantages of The British Computer Society is its wide appeal. In these days, we frequently hear of the dangers inherent in specialisation, and I am sure that they are present in this field as in any other. As I understand from the aims of the Society, they too are aware of these dangers and intend to combat them. We are very pleased too!"

The aims and objects of the Society were described in detail by Mr. A. J. Bray, M.A., A.C.A., speaking as a representative of Council. After dealing with the formation and administration of the Society, he went on to deal with the activities planned for the current session: "The Business Group has organised 27 study groups in 22 subjects for this session, each group usually meeting once a month from October to April, and producing its findings in report form. These reports will then be collated and edited, published and issued to all members, probably in a special issue of THE COMPUTER BULLETIN. In No. 3, on display here this evening, can be seen the similar published reports of the 22 study groups of the London Computer Group in the 1956/57 session.

"The Scientific Group are planning colloquia over a wide variety of subject in their particular field, and details of these will be issued to members as soon as the arrangements have been completed."

After dealing with the arrangements for regular meetings in London, and drawing attention to the value of THE COMPUTER BULLETIN, Mr. Bray continued: "Arrangements have now been completed for the publication by the Society of its own Journal, in addition to the Bulletin. The first number will be published in the early months of 1958, and issued free to all members; it will contain articles of merit especially written for the

Society and other material of permanent interest, in both scientific and business fields.

"In addition to these two regular publications of the Society, other information of valur to members is issued from time to time; for example, the Society maintains a list of available courses known to be offered in various parts of the United Kingdom by Universities, Technical Colleges, professional bodies and manufacturers --- and this list is issued before each session."

Mr. Bray next gave some information of the relationship of the Society with other bodies, and of its participation in the British Conference on Automation and Computation; concluding, he expressed the hope that "in describing our activities and the arrangements which we have made, I have illustrated the real value of membership of the Society wherever you live.

"As our Branches form in the major towns and cities throughout the United Kingdom and develop their own arrangements for lectures, colloquia and other activities, we hope that, wherever a member lives, he will enjoy the full benefits of active membership and that, with regular receipt of the Society's publications, he will be able to maintain close contact with all that is developing in this ever-increasing field and share the experiences and knowledge of his fellow members."

Following the unanimous acceptance of a resolution proposing the formation of a Glasgow Branch of the Society, subject to the approval of Council, the following were elected to form the initial committee until 30th April 1958: Dr. D.C.Gilles (Chairman), Mr. W.B.Mackay, Professor D.C.Pack, Messrs. T.B.Simpson and J.J.B.Young, with Mr. K.D. HENDERSON as Honorary Secretary, at 89 Wellington Street, Glasgow, C.2.

1958 WESTERN JOINT COMPUTER CONFERENCE

The next Western Joint Computer Conference will be held in Los Angeles on May 6th - 9th, 1958, sponsored jointly by the A.C.M, I.R.E., and A.I.E.E.

The theme will be "Contrasts in Computers" - i.e. controversial questions such as binary versus decimal numbers, single or multiple address order codes, etc. There will also be a day given over to a Report from the Manufacturers, sponsored by the A.C.M.

SOCIETY NOTES & COUNCIL NEWS

The British Computer Society Limited was registered as a company limited by guarantee on the 14th October, to take over the British Computer Society, the Members transferring without additional fees or subscriptions, and the Council of the Society becoming the first directors of the Company.

Under the Memorandum and Articles of the Society (by which title the Company will be known) each Member "undertakes to contribute to the assets of the Society, in the event of the same being wound up while he is a Member, or within one year after he ceases to be a member, for payment of the debts and liabilities of the Society, contracted before he ceases to be a Member, and of the cost, charges and expenses of winding up, and for the adjustment of the rights of the contributors among themselves, such amount as may be required not exceeding one pound sterling."

Forms of application for membership, embodying this undertaking, are being sent to all Members for completion and signature so that they may be formally registered; failure to do this will result in the Member losing his voting rights at the end of the current year (30th April). These forms themselves will form the Register of Members.

REDUCED SUBSCRIPTION RATE FOR NEW MEMBERS

Council have decided that, having regard to the fact that the current year is a formative one during which news of the Society's existence has been spreading, and without prejudice to future years, the subscription for the current year to 30th April 1958 to be paid by Members whose first applications are received after 1st January 1958 should be at the reduced rate of two guineas. There is no reduction in entry fee.

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STUDENTS

Since all Members of the Society have to give the undertaking (referred to above) required of members of a company limited by guarantee, Associate Membership cannot be made available to those under 21 years of age as it is impracticable to enforce the undertaking in respect of minors. Council have therefore decided that minors shall be eligible to become Students of the Society "if, having attained the age of 18 years and being otherwise eligible to become Associate Members, they are under 21 years of age on the first day of May last preceding their application for registration, and they will be eligible to remain as Students until the first day of May next following the day on which they become 21 years of age.

"In all other respects they will have the same rights and be liable for the same subscription as Associate Members . . . , but not being Members of the Society they shall not be entitled to receive notice of or to attend General Meetings, nor will they have any liability under Clause 8 of the Memorandum of Association" (the guarantee referred to above). General Meeting in this context means a business meeting, and not lecture meetings, etc.

REGIONAL BRANCHES

Council has approved the formation of Regional Branches of the Society at Manchester (14th October 1957), Birmingham (1st November) and Glasgow (11th November). Reports of the inaugural meetings of these Branches appear in this issue.

ANALOGUE COMPUTERS

Several Members have expressed interest in the possibility of the Society providing facilities for those interested in analogue computing. It would be of assistance if those who would wish to be associated with any such activity would advise the Secretary, at the Society's offices.

ADDITIONAL LONDON MEETINGS

In addition to the regular monthly meetings in London already announced (and shown in the 1957/58 Membership Card and Programme) a series of additional meetings has been arranged, at which there will be a lecture and discussion on a somewhat technical topic.

These meetings will be of interest mainly to scientists and engineers but they are of course open to all members of the Society. Details are being circulated to members, and future meetings will be given in Members' diary in THE COMPUTER BULLETIN.

THE COMPUTER JOURNAL

Starting in April, the Society will be publishing each quarter THE COMPUTER JOURNAL containing papers and articles covering all aspects of the use of electronic computers — both digital and analogue — and related techniques. Papers on the logical design of these machines, and news of new developments, will also appear. The journal will be complementary to THE COMPUTER BULLETIN. Both periodicals will be issued free to all Members of the Society.

APPOINTMENT OF ASSISTANT SECRETARY

Miss Miss D.J.Aldis, who has been a member of the staff of the Society since its formation, and previously with the London Computer Group, has been appointed Assistant Secretary of the Society.

SOLATRON

In the displayed advertisement on page 130 of our last issue for the Solartron Electronic Group Ltd., the company was referred to incorrectly throughout as 'Solatron'.

Some advertising matter, including the copy for this advertisement, was accepted at a late date and handled by our own typographer; we express our regret to the Solartron company for this error in publication.

MANUFACTURERS' NEWS

CRYOTRON STORE

IBM has announced that it is developing a cryotron storage unit. This type of store which was first invented at the Massachusetts Institute of Technology makes use of "superconductivity", or the complete disappearance of electrical resistance at temperatures near to absolute zero.

This is probably the first practical application of this strange phenomenon, which has not yet been properly explained by physicists. The temperatures required are so low that all substances are solid except helium, and the refrigeration is performed by letting liquid helium boil. To make the job easier the unit is kept as small as possible and is put in a vacuum flask to stop it warming up.

The metal lead exhibits the phenomenon most readily and is being used by IBM. To keep the size small, printed circuit techniques are being used.

ELECTRONICS FOR ATOMICS

The first Hollerith Type 555 Electronic Calculator has recently been delivered and is now in operation by the Computer Group of the UK Atomic Energy Authority at Harwell.

The machine is being used almost exclusively for data-processing and repetitive computation.

DIRECT DOCUMENT READING

Boots Pure Drug Co. Ltd., have ordered the first Solartron ERA (Electronic Reading Automaton) for reading the printed sales record off cash register tally rolls, at a speed of 200/300 characters per second.

The reader will be linked to a special type of accumulator for accounting and statistical totalling.

ON FEELING PULSES

Viewers of the BBC Television Programme 'It's Magic' on November 1st got a new slant on an old controversy when a professional mind-reader, blindfolded, succeeded in telling the moves made by a noughts-and-crosses machine. If thought-reading can be extended to reading the activity of a machine, must we conclude that the machine is thinking?

Further experiments immediately suggest themselves. The machine used on television worked by means of telephone relays and uniselectors. Would thermionic valves provide such unmistakeable ethereal emanations? How would transistors behave, with their minute power levels? Such experiments might prove of great practical value for if, through refinements of technique, it could be made possible for all normal mortals to tune in to the mystic messages, we could dispense entirely with our present clumsy printing devices and let telepathy do the trick.

Of course, the demonstration could easily have been a hoax. The mind-reader was probably merely reading the minds of the people in the studio who were watching the machine.

THE ELLIOTT 405 COMPUTER

In THE COMPUTER BULLETIN No. 3, the maximum access time of a nickel delay line in an Elliott 405 Computer was given in error as 1 530 milliseconds, instead of 1.530 milliseconds (p. 95, Report (6), section 5). We regret any inconvenience caused to Messrs. Elliott Brothers (London) Ltd. for any inconvenience caused by this typographical error.

BOOK REVIEW

AUTOMATIC CODING : Monograph No. 3, published by The Journal of the Franklin Institute April 1957, 118 pages

This monograph consists of the proceedings of a symposium held at the Institute in January 1957. The title, "automatic coding", has in the computer field come to mean the use of a computer in preparing instructions for a computer.

High praise has often been awarded to automatic coding schemes of various kinds, and this must have led many people to wonder how it is that many programs are still written in "old-fashioned" forms of coding, and also why it should be necessary for several different schemes or "auto-codes" to be written for the same computer. The book under review gives a wealth of information about schemes currently being used or devised in the United States, but unfortunately does little to clarify the basic principles involved.

It must be confessed that there exists a certain class of programmers who find the invention of auto-codes a more exciting challenge than the programming of live jobs, possibly because it needs apparently no knowledge beyond an ability to write programmes.

However, the real test of an auto-code is not whether it works, but whether people use it. To satisfy this requirement a considerable amount of experience must be available to the inventor.

It is fashionable, and to some extent useful, to think of auto-codes as providing a new "language" which is easier for a programmer to use than the code of the machine itself. But there is a subsidiary and often conflicting aim which is easily forgotten, and this is that the new language should also be easy to assimilate.

Moreover, the optimum language depends on the type of application for which it is to be used, in particular whether it is for business or scientific problems or both.

The inventor of an auto-code is up against two major difficulties. Firstly, he is bound by the limitations of the equipment which is used to transcribe the program for input to the computer. In particular, he may be seriously handicapped by the range of characters at his disposal. The second difficulty, which is more fundamental, is that the language in which we express ourselves most readily occasionally requires a high degree of intelligence to interpret, because the meaning may be strictly ambiguous although it may be, for practical purposes, "apparent from the context". To build this intelligence into the computer is possible only to a limited extent.

One current trend which can be discerned is towards the use of complete English words and phrases, although these are still hedged in by restrictions many of which appear at first sight somewhat artificial. Until recently this trend was hampered by a restriction which was not in fact at all fundamental, arising out of the fact that computers mostly prefer to accept information in "words" of a fixed length.

This has frequently led to a quaint assortment of packaged abbreviations euphemistically termed "mnemonic coding", including such monstrosities as (to quote at random from the Franklin monograph) TRADD, MIPIR, ARGUM, FINUM, ADF, MPF, DIUFIL. This restriction is now being abandoned and the Sperry Rand "B-zero" compiler which is intended for business use and which accepts a program consisting almost entirely of English words and phrases.

For scientific use, the "algebraic coding" type of scheme is still a strong favourite. The principal exponent in this country is MR. R.A.Brooker at Manchester University. The most notable schemes in the United States have been that of Laning and Zieler at M.I.T. and FORTRAN for the IBM 704. Unfortunately

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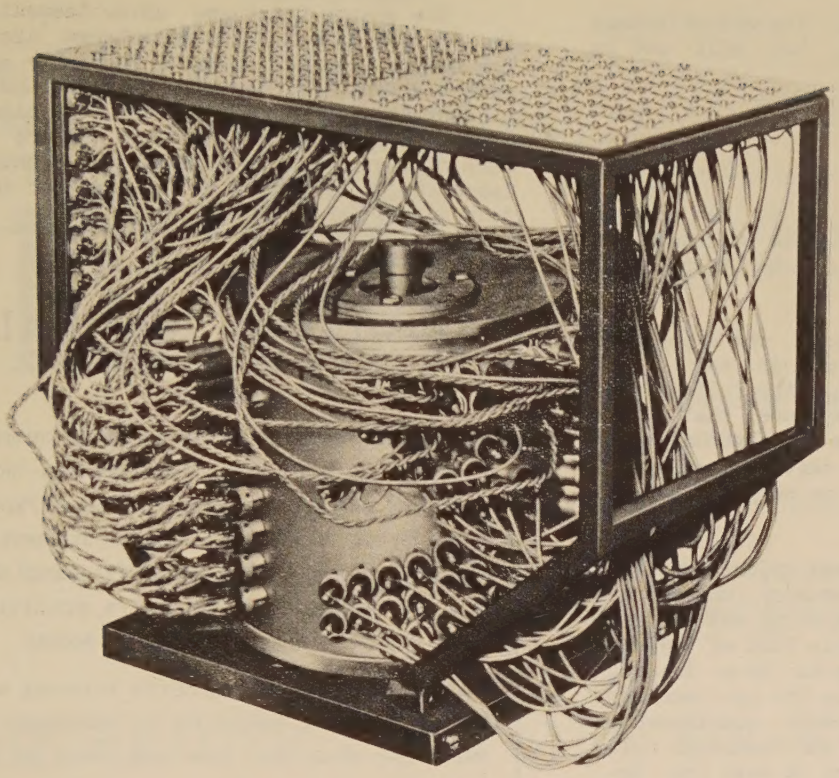
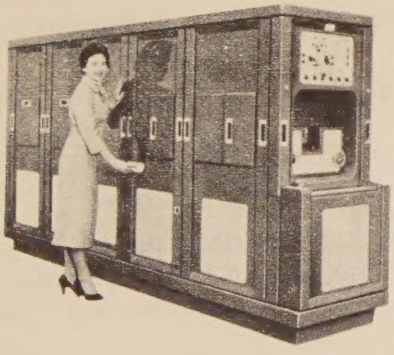


head for figures

This is the storage drum (the 'memory') of the Powers-Samas PCC. It stores wanted data for a complete accounting routine, along with other data not immediately needed. The Powers-Samas PCC is a full scale electronic computer for commercial industrial and public service accounting. With the PPC, the "Emp" Electronic Calculator and other electronic machines. Powers-Samas are bringing the very latest techniques to the service of industry.



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CORRESPONDENCE

Letters are welcomed. The writer's name and address must be given, but will not be published if requested.

DO WE LACK BRAINS?

Sir,

A fee of 85 guineas is to be charged for a course on electronic data processing in London in January, to be run by "a team of experts from New York".

I have no wish to decry the importance of the work now being done in the United States, and of our making the fullest possible use of all the experience that exists in this new field. But is this country really so bankrupt in brains that we must squander our slender resources on complete courses prefabricated abroad?

To do so is a harsh and unjust criticism of those who made this country one of the pioneers of electronic computing and who are striving in the face of this kind of "transatlantic complex" to keep us in a leading position. It also ignores the praiseworthy efforts now being made, with considerable success, by Universities and Technical Colleges throughout the country to meet the demand for training in this subject.

"One of Britain's Experts"
(Name and Address supplied)

BOOK REVIEW
continued from page 154)

none of these schemes feature in the present publication.

The book does, however, contain an example of the abstract mathematical approach in a paper by Perlis and Smith. The result arrived at, after several pages of theorising, is disappointingly clumsy in appearance.

The book also contains a useful discussion on the "de-bugging" of automatic coding and a refreshing final paper which proposes that all the important facilities provided by automatic coding schemes can in fact better be provided by suitably designing the machine.